

# USB Type-C ENGINEERING CHANGE NOTICE

**Title: Timing for Ra removal and restoring Ra**  
**Applied to: USB Type-C Specification Release 2.0, August 2019**

## **Brief description of the functional changes proposed:**

Provide specific timing for a cables, VPAs, and VPDs to remove and restore Ra. Create a new Ra management state machine to make the cable requirements clear. vVconnDisconnect minimum is increased to provide margin.

## **Benefits as a result of the proposed changes:**

Ensure interoperability with sources, sinks, cables, VPDs and VPAs. If Ra is not re-applied by the time the source applies its Rp, then the VCONN cable connection can look like an Rd causing the source to enter Attached.SRC unless the cable reapplies Ra within specified time.

## **An assessment of the impact to the existing revision and systems that currently conform to the USB specification:**

The timing to remove Ra and restore Ra was previously not called out explicitly. Cable plugs, VPDs, and VPAs may need to be updated to meet the requirements.

## **An analysis of the hardware implications:**

The cable plug, VPD and VPA should already have hardware functionality to re-apply Ra. The value of tRaReconnect may impact some implementations.

## **An analysis of the software implications:**

Software implementations may need to be updated to reflect the timing requirements.

## **An analysis of the compliance testing implications:**

A new compliance test needs to be implemented to check that the cable plug, VPD, and VPA restore Ra per the required timing. It should be checked that the cable monitors VCONN at both ends of the cable. It should be checked that the VCONN is properly monitored after a VCONN\_swap and a PR\_Swap.

# USB Type-C ENGINEERING CHANGE NOTICE

## Actual Change Requested

### (a). Section 4.4.3 VCONN, Page 145

#### Existing Text:

The cable shall remove or weaken **Ra** when VCONN is in the valid voltage range (**vVCONNValid**). The cable shall reapply **Ra** when VCONN falls below **vRaReconnect** as defined in Table 4-6. The cable shall discharge VCONN to below **vVCONNDischarge** on a cable disconnect. The cable shall take into account the VCONN capacitance present in the cable when discharging VCONN.

#### New Text:

The cable shall remove or weaken **Ra** according to the state-diagram behavior in Section 4.5.2.x. ~~when VCONN is in the valid voltage range (vVCONNValid).~~ The cable shall reapply **Ra** according to the state-diagram behavior in Section 4.5.2.x. ~~when VCONN falls below vRaReconnect as defined in Table 4-6. The cable shall control Ra at each of its ends independently based on the VCONN on that end. The cable shall discharge VCONN to below vVCONNDischarge on a cable disconnect. The cable shall take into account the VCONN capacitance present in the cable when discharging VCONN.~~

### (b). Section 4.4.3 VCONN, Table 4-6, Page 145

#### Existing:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range ( <b>vVCONNValid</b> ) over which this table applies
Power for Electronically Marked Passive Cables		20mW	See Section 4.9. Measured with no USB PD traffic at least 500ms after VCONN applied Note: 75mW max allowed for the first 500ms after VCONN applied.
vRaReconnect	800mV		Voltage at which the cable shall reapply Ra on the falling edge of VCONN.

#### New:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range ( <b>vVCONNValid</b> ) <del>when VCONN is valid over which this table applies. There can be some additional IR drop.</del>
Power for Electronically Marked Passive Cables		20mW	See Section 4.9. Measured with no USB PD traffic at least <del>tRaWeaken500ms</del> after VCONN applied Note: 75mW max allowed for the first <del>tRaWeaken500ms</del> after VCONN applied.
<del>vRaReconnect</del>	<del>800mV</del>		<del>Voltage at which the cable shall reapply Ra on the falling edge of VCONN.</del>
<u>vVconnDisconnect</u>	<u>1 V</u>	<u>2.4 V</u>	<u>Threshold used to detect VCONN disconnect.</u>
<u>tRaReconnect</u>		<u>1ms</u>	<u>Time from VCONN falling below <b>vVconnDisconnect</b> at the Cable Plug until the cable has re-applied the Ra.</u>
<u>tRaWeaken</u>	<u>21ms</u>	<u>1.2s</u>	<u>Time from VCONN exceeding <b>vVconnDisconnect</b> until the cable removes or weakens Ra.</u>

# USB Type-C ENGINEERING CHANGE NOTICE

## (c). Section 4.4.3 VCONN, Table 4-7, Page 146

### Existing:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range (vVCONNValid) over which this table applies
vRaReconnect	800mV		Voltage at which the VPA shall reapply Ra on the falling edge of VCONN.
vVconnDisconnect	800 mV	2.4 V	Threshold used to detect VCONN disconnect.

### New:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range (vVCONNValid) <u>when VCONN is valid over which this table applies.</u>
vRaReconnect	800mV		Voltage at which the VPA shall reapply Ra on the falling edge of VCONN.
<u>tRaWeaken</u>		<u>1.2s</u>	<u>Time from VCONN entering the valid region until the VPA removes or weakens Ra.</u>
vVconnDisconnect	<u>800 mV 1 V</u>	2.4 V	Threshold used to detect VCONN disconnect.

## (d). Section 4.4.3 VCONN, Page 146

### Existing:

The VCONN powered accessory shall remove or weaken Ra when VCONN is in the valid voltage range (vVCONNValid). The VCONN powered accessory shall reapply Ra when VCONN falls below vRaReconnect as defined in Table 4-7. The VCONN powered accessory shall take into account the VCONN capacitance present in the accessory when discharging VCONN.

### New:

The VCONN powered accessory shall remove or weaken Ra within tRaWeaken after when VCONN is enters in the valid voltage range (vVCONNValid).

The VCONN powered accessory shall reapply Ra when VCONN falls below vRaReconnect as defined in Table 4-7. The VCONN powered accessory shall discharge VCONN to below vVCONNDischarge within tVCONNDischarge on a cable disconnect. The VCONN powered accessory shall take into account the VCONN capacitance present in the accessory when discharging VCONN.

# USB Type-C ENGINEERING CHANGE NOTICE

## (e). Section 4.4.3 VCONN, Table 4-8, Page 147

### Existing:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range ( <b>vVCONNValid</b> ) over which this table applies
vRaReconnect	800mV		Voltage at which the VPD shall reapply Ra on the falling edge of VCONN.
vVconnDisconnect	800 mV	2.4 V	Threshold used to detect VCONN disconnect.

### New:

	Minimum	Maximum	Notes
Voltage	3.0V	5.5V	Voltage range ( <b>vVCONNValid</b> ) <u>when VCONN is valid over which this table applies.</u>
vRaReconnect	800mV		Voltage at which the VPD shall reapply Ra on the falling edge of VCONN.
<u>tRaWeaken</u>		<u>1.2s</u>	<u>Time from VCONN entering the valid region until the VPD removes or weakens Ra.</u>
vVconnDisconnect	<u>800 mV 1 V</u>	2.4 V	Threshold used to detect VCONN disconnect.

## (f). Section 4.4.3 VCONN, Page 147

### Existing:

The VPD shall remove or weaken Ra when VCONN is in the valid voltage range (**vVCONNValid**).

The VPD shall reapply Ra when VCONN falls below vRaReconnect as defined in Table 4-8. The VPD shall take into account the VCONN capacitance present in the device when discharging VCONN.

### New:

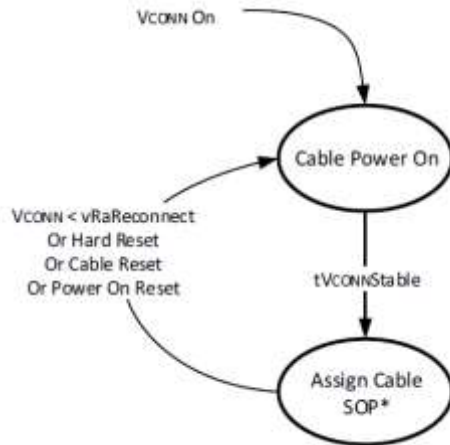
The VPD shall remove or weaken Ra within tRaWeaken after when VCONN is in enters the valid voltage range (**vVCONNValid**).

The VPD shall reapply Ra when VCONN falls below vRaReconnect as defined in Table 4-8. The VPD shall discharge VCONN to below vVCONNDischarge within tVCONNDischarge on a cable disconnect. The VPD shall take into account the VCONN capacitance present in the device when discharging VCONN.

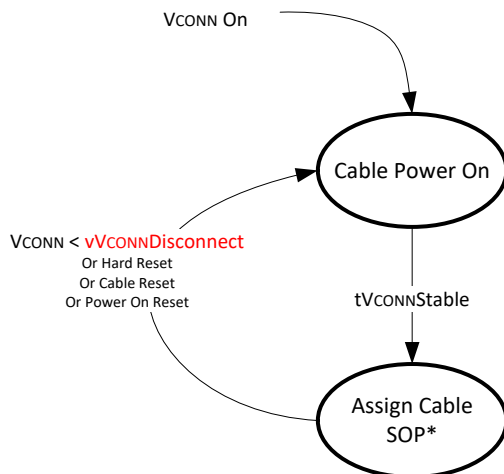
# USB Type-C ENGINEERING CHANGE NOTICE

(h). Section 4.5.2.4 Cable State Machine Requirements, Figure 4-20, Page 194

## Existing Figure:



## New Figure:



(i). Section 4.5.2.4.1.1 Cable Power On State Requirements, Page 194

## Existing Text:

Each eMarker in the cable shall present **Ra** when no VCONN is applied.

Each eMarker in the cable shall power on and may continue to present **Ra** in this state.

The cable shall not respond to SOP' and SOP'' commands in this state.

# USB Type-C ENGINEERING CHANGE NOTICE

## New Text:

~~Each eMarker in the cable shall present Ra when no VCONN is applied.~~

Each eMarker in the cable shall power on, ~~and may continue to present Ra in this state.~~

The cable shall not respond to SOP' and SOP'' commands in this state.

## (j). Section 4.5.2.4.2.1 Assign Cable SOP\* State Requirements, Page 195

### Existing Text:

Each eMarker in the cable shall weaken or remove Ra if it has not already done so.

Passive cables shall meet the Power for electronically marked passive cables defined in Table 4-6.

Active Cables shall meet the Power for Active cables in Table 4-6.

## New Text:

~~Each eMarker in the cable shall weaken or remove Ra if it has not already done so.~~

~~Passive cables shall meet the Power for electronically marked passive cables defined in Table 4-6.~~

~~Active Cables shall meet the Power for Active cables in Table 4-6.~~

## (k). Section 4.5.2.4.2.1 Exiting from Assign Cable SOP\* State, Page 195

### Existing Text:

Each eMarker in the cable shall transition to Cable Power On upon sensing VCONN less than vRaReconnect or upon a Power On Reset event.

Each eMarker in the cable shall transition to Cable Power On upon sensing a Hard Reset or Cable Reset.

## New Text:

Each eMarker in the cable shall transition to Cable Power On upon sensing VCONN less than ~~vVconnDisconnectRaReconnect~~ or upon a Power On Reset event.

Each eMarker in the cable shall transition to Cable Power On upon sensing a Hard Reset or Cable Reset.

## (l). Section 4.5.2.2.6.2 Exiting from the UnattachedWait.SRCState, Page 175

### Existing Text:

The port shall transition to Unattached.SRC when both VCONN is turned off and the CC pin is below vVCONNDISCHARGE.

## New Text:

# USB Type-C ENGINEERING CHANGE NOTICE

The port shall transition to Unattached.SRC after the VCONN pin is below  $vVCONNDischarge$ . The port may delay this transition to allow the cable plug more time to reapply Ra.

## (m). Section 4.5.2.4 heading, Page 194

### Existing Heading:

Cable State Machine Requirements

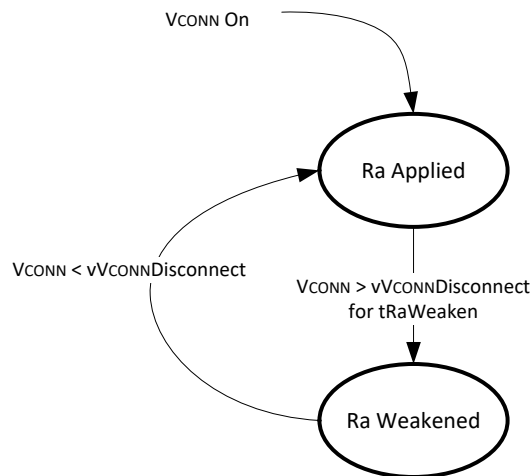
### New Heading:

Cable SOP\* Assignment State Machine Requirements

## (n). Section 4.5.2.x new sections, Page 195

### 4.5.2.x Cable Ra Management State Machine Requirements

Figure 4-xx illustrates the eMarker state-machine for applying and weakening or removing Ra. This state machine is executed independently on each end of the cable. This state-machine runs independently from the Assign SOP\* state machine.



#### 4.5.2.x.1 Ra Applied State

This state appears in Figure 4-xx. This is the initial state at power on for each eMarker in the cable.

##### 4.5.2.x.1.1 Ra Applied State Requirements

Each eMarker in the cable shall apply Ra to VCONN within  $tRaReconnect$ .

##### 4.5.2.x.1.2 Exiting from Ra Applied State

Each eMarker in a passive or active cable shall transition to the Ra Weakened state when VCONN is greater than  $vVCONNDisconnect$  for  $tRaWeaken$ .

#### 4.5.2.x.2 Ra Weakened State

# USB Type-C ENGINEERING CHANGE NOTICE

This state appears in Figure 4-xx.

## **4.5.2.x.2.1 Ra Weakened State Requirements**

The eMarker in the cable shall remove or weaken Ra.

Passive cables shall meet the Power for electronically marked passive cables defined in Table 4-6.

Active Cables shall meet the Power for Active cables in Table 4-6.

## **4.5.2.x.2.2 Exiting from Ra Weakened**

Each eMarker in a passive or active cable shall transition to the Ra Applied state when VCONN is below vVCONNDisconnect.